1. Introduction

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In the twentieth and twenty-first centuries, the warming of the global climate system is becoming increasingly obvious and further warming is expected. This warming is accompanied with changing precipitation conditions, causing more frequent and more serious natural disasters (IPCC 2007). In the last century a 0.8°C rise in surface temperatures and a 60–80 mm decrease in precipitation were detected also in the Carpathian Basin, where water shortage is one of the greatest natural hazards causing serious damages to national economy, especially to agriculture and water resources in the affected years (Rakonczai 2011). Due to that, research, monitoring and forecasting become of great importance worldwide. Since increasing frequency of droughts and increased stress on water resources have been experienced in the last decades in Europe, the European Commission has been increasingly focusing on water-related problems. Many places showed spectacular landscape changes caused by increasingly rapid alterations of environmental parameters. Direct impacts of drought can be reduced crop productivity or quality, loss of wildlife habitat and forage, higher livestock and wildlife mortality, reduced availability of water resources and increased incidence of wildfires. Indirect impacts may include loss of income, occupational displacement, rural-urban migration, deepening socio-economic inequality, social and political conflict and increased human mortality. Drought can be considered as a 'trigger' event that causes damage by exploiting underlying (and sometimes long-standing) social vulnerabilities within populations exposed to its effects (Wisner et al. 2004).

The quantity and the temporal distribution of precipitation are some of the most important factors in defining the formation and severity of drought. Precipitation is definitive for the vegetation during the growing period (especially in the water-intensive developmental phase), however, the precipitation in autumn-winter, in the accumulation period, is also important, because a major part of it is stored in the soil, and it is accessible for the vegetation. Precipitation is the major influencing factor of the spatial and temporal appearance of drought. Apart from precipitation and the lack of precipitation, another important meteorological factor is the evaporative capacity of the air, which mostly depends on temperature, but other circumstances (sunshine duration, wind speed, etc.) also influence it. Based on experience, the most severe droughts occur in Hungary when long summer periods without precipitation, or with little precipitation, are accompanied by extreme heat. This can be strengthened by low precipitation periods in the preceding winters.

Besides meteorological elements, local features can modify drought. Thicker fertile topsoil and more porous soil are able to absorb and store more water accessible (utilizable) for plants. That is, the water management properties of the soil play a significant role in the formation of drought, and in the mitigation of its effects. Chernozem soils have the most advantageous properties from this point of view, while sandy soils, clayey soils, and salt affected soils are at a disadvantage.

Soil moisture is also determined by the topography and the depth of groundwater. By increasing slope the proportion of run-off increases and infiltration decreases. If the groundwater is situated very deeply, the vegetation does not get water supply, but if it is higher, it noticeably contributes to the water uptake of plants, due to capillary rise.

Despite the serious consequences of the phenomenon, drought is not a well-defined term, because it is difficult to define its actual beginning, duration, ending and to quantify its intensity and impacts. The scientific and the everyday language use this term in a very different sense, as well.

That's why there are several definitions of drought, even if we only consider the scientific ones (not the cultural). Basically, we speak of a situation of water shortage, when the precipitation is less than the average, and it cannot meet water needs. The process, the duration of which is difficult to measure, or to predict, is often defined by its impacts. Thus, there are meteorological (Palmer 1965, Faragó et al. 1989), pedological, agricultural (Maracchi 2000), or hydrological drought types (Pálfai 2002, Hisdal and Tallaksen 2003). Though the extent and effects of drought are difficult to define, a numerical value is necessary in order to assess and compare droughts. Various indices and indicators have been created for this purpose. The indices are designed to indicate water shortage. More than a hundred indices are known (Zargar 2011), each of them attempt to characterise the intensity of droughts being different in appearance. The quantity of precipitation (its deviation from the mean) is an important element of the indices, and most of them deal with temperature, evaporation, the quantity of water stored in the soil, or in the vegetation. Besides drought indices, land use, or yield average data may be necessary to analyze the severity of drought. In the Carpathian Basin the SPI index, which calculates from precipitation data, and the Pálfai index (Pálfai 1989, Pálfai and Herceg 2011), which applies data on precipitation, temperatures, and groundwater, are the most often calculated to define the severity of drought.

Drought is a climatic phenomenon that can be various regarding its location and duration, too. The state created by abnormal water supply can last from a few days to long years. For example, the drought, damaging the settlement of Cahiokia, USA, around 1150, may have lasted for fifteen years. Anasazi, a settlement in today's New Mexico, inhabited by tens of thousands of Native Americans, was abandoned mysteriously in the 13th century, supposedly as a result of drought (Benson et al. 2007). Roanoke (the first English settlement in the East Coast) was depopulated as a result of the most severe drought of the past centuries, between 1587 and 1589, and the doom of Jamestown was the climatic process happening between 1606 and 1612. Some very serious periods of drought have also occurred in the Carpathian Basin in the past 1000 years, mainly between 1142 and 1147, in 1363, in 1794, between 1863 and 1865, when drought had significant social-economic consequences through limiting food and potable water supplies (Pálfai 1987). These droughts involved the loss of human life, though its scale did not reach the scale of the American examples. The extent of the effects of drought depends not only on the environmental, especially the climatic features of the region, but also on the role of the society, mainly in the field of mitigating the consequences.

The role of the society and the planning of water management are becoming more and more important because of the consequences of the more and more frequent climatic extremes and hydro-climatic hazards. When handling conflicts connected to water shortage, the areas of water use with different interests (conservation, agriculture, and industry) have to be synchronised. Exactly because of this, our research aims at the elaboration of land use and water management solutions integrating a number of conditions, to mitigate the growing problem of water shortage.